CubeSat Deformable Mirror Demonstration

Completed Technology Project (2012 - 2016)

Project Introduction

The goal of the CubeSat Deformable Mirror Demonstration is to characterize the performance of a small deformable mirror over a year in low-Earth orbit. Small form factor deformable mirrors are a key technology needed to correct optical system aberrations in applications such as space-based direct imaging of exoplanets with coronagraphic telescopes. They can also improve distortions and reduce bit error rates for low-power space-based laser communications. While we envision future development of a generic 3U CubeSat platform capable of testing several different mirrors, our first design accommodates a 32-actuator Boston Micromachines MEMs deformable mirror. The approach is simple in order to accommodate all components within the tight mass, volume, and power requirements of a 3U CubeSat (the CubeSat platform allows access to piggyback on a primary payload for launch, and targets university student research). The payload consists of a coherent internal light source directed to the deformable mirror, then split to a Shack-Hartmann wavefront sensor and a detector. The descope option is use a Michelson interferometer approach instead of a wavefront sensor. We will continuously run an optimized set of configurations on the deformable mirror over the mission to characterize on-orbit performance. The MIT Space Systems Lab has expertise in building CubeSat platforms, and we have allocated 1.5U of the 3U CubeSat to the payload. This design has minimal requirements for pointing and attitude control (just for power and communications) but we will develop interfaces with the needs of higher-accuracy future missions in mind. The proposed work is significant to both the objectives of the NSTRF solicitation and to NASA interests. Space-based adaptive optics systems are helpful to remote sensing and imaging of exoplanets and to optical communication systems. The development of this critical technology will ultimately improve future capabilities of NASA missions, which directly coincides with the 2011 NASA Strategic Plan.

Anticipated Benefits

Small form factor deformable mirrors are a key technology needed to correct optical system aberrations in applications such as space-based direct imaging of exoplanets with coronagraphic telescopes. They can also improve distortions and reduce bit error rates for low-power space-based laser communications. This work is significant to both NSTRF objectives and to NASA interests. Space-based adaptive optics systems are helpful to remote sensing and imaging of exoplanets and to optical communication systems. The development of this critical technology will ultimately improve future capabilities of NASA missions, which directly coincides with the 2011 NASA Strategic Plan.

Project Image CubeSat Deformable Mirror Demonstration

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

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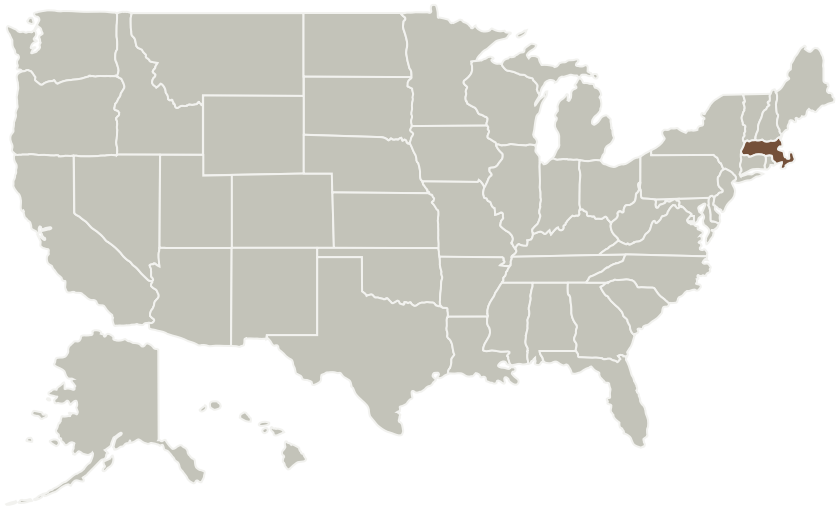
Primary U.S. Work Locations and Key Partners



Primary U.S. Work Locations
Massachusetts

Images

11524-1363119621707.jpg
Project Image CubeSat Deformable Mirror Demonstration
(https://techport.nasa.gov/image/1737)

Project Management

Program Director:
Claudia M Meyer

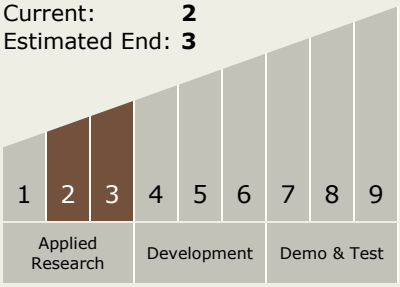
Program Manager:
Hung D Nguyen

Principal Investigator:
Kerri Cahoy

Co-Investigator:
Anne D Marinan

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.2 Thermal Control Components and Systems
    - TX14.2.8 Measurement and Control

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Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html